TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 USC 371

International Application No.:	PCT/RU99/00062
International Filing Date:	March 4, 1999
Priority Date Claimed:	December 8, 1998
Title of Invention:	CONTACT NODE
Applicant(s) for DO/EO/US:	Alexsander Ivanovich Taran

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. (X) This is a **FIRST** submission of items concerning a filing under 35 USC 371.

2. () This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 USC 371.

3. (X) This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).

4. () A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. (X) A copy of the International Application as filed (35 USC 371(c)(2))

   a) (X) is transmitted herewith (required only if not transmitted by the International Bureau).
   b) () has been transmitted by the International Bureau.
   c) () is not required, as the application was filed in the United States Receiving Office (RO/US).

6. (X) A translation of the International Application into English (35 USC 371(c)(2)).

7. (X) Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3))

   a) () are transmitted herewith (required only if not transmitted by the International Bureau).
   b) () have been transmitted by the International Bureau.
   c) () have not been made; however, the time limit for making such amendments has NOT expired.
   d) (X have not been made and will not be made.

8. () A translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).

9. (X) An oath or declaration of the inventor(s) (35 USC 371(c)(4)).

10. () A copy of the International Preliminary Examination Report with any annexes thereto, such as any amendments made under PCT Article 34.

11. () A translation of the annexes, such as any amendments made under PCT Article 34, to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

12.	()	An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
13.	()	An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
14.	(X)	A FIRST preliminary amendment.
	()	A SECOND or SUBSEQUENT preliminary amendment.
15.	()	A substitute specification.
16.	()	A power of attorney and/or address letter.
17.	(X)	International Application as published.
18.	(X)	Small Entity Statement.
19.	()	PCT Form PCT/IPEA/402.
20.	()	PCT Form PCT/IB/308.
21.	()	PCT request form.
22.	(X)	Other Items or information: International Search Report
23.	(X)	A return prepaid postcard.
24.	(X)	The following fees are submitted:

				FEES
	BASIC FEE			$1,000
CLAIMS	**NUMBER FILED**	**NUMBER EXTRA**	**RATE**	
Total Claims	34 - 20 =	14 ×	$18	$252
Independent Claims	2 - 3 =	0 ×	$80	$0
Multiple dependent claims(s) (if applicable)			$270	$0
	TOTAL OF ABOVE CALCULATIONS		$1252	
Reduction by 1/2 for filing by small entity (if applicable). Verified Small Entity statement must also be filed. (NOTE 37 CFR 1.9, 1.27, 1.28)			$	
	TOTAL NATIONAL FEE			$1252
	TOTAL FEES ENCLOSED			$1252
		amount to be refunded:		$
		amount to be charged:		$

25. () The fee for later submission of the signed oath or declaration set forth in 37 CFR 1.492(e) will be paid upon submission of the declaration.

26. (X) A check in the amount of $1252 to cover the above fees is enclosed.

27. () Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40 per property.

28. (X) The Commissioner is hereby authorized to charge only those additional fees which may be required, to avoid abandonment of the application, or credit any overpayment to Deposit Account No. 11-1410.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Taran, Alexsander Ivanovich	Group Art Unit Unknown
Appl. No.	: Unknown	
Filed	: Herewith	
For	: CONTACT NODE	
Examiner	: Unknown	

I hereby certify that this correspondence and all marked attachments are being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on

April 27, 2001
(Date)

John M. Carson, Reg. No. 34,303

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Please enter the following amendment to the above-referenced application before examination of the application on the merits.

IN THE CLAIMS:

Please cancel Claims 1-23.

Please add the following claims:

24. (New) A contact node comprising:

at least two metallized contacts coupled with conductive paths arranged on surfaces of connection layers made on the base of a dielectric material and mutually aligned and interconnected electrically and mechanically by a conductive binding material, wherein it is made in the form of a joint between a contact made in the form of a metallized contact pad coupled with the conductive paths on the surface of the connection layer, and a respective contact joined with the contact pad and made in the form of a metallized hole in an upper-lying connection layer, the lower edge of the metallized hole

being faced to the metallized contact pad on the surface of the underlying connection layer, and the upper edge of the hole being coupled with the conductive paths on the upper surface of the upper-lying connection layer.

25. (New) The contact node according to Claim 24, wherein the metallized hole is in the form of a cylinder.

26. (New) The contact node according to Claim 25, wherein the upper edge of the metallized hole coupled with the conductive paths on the surface of the connection layer forms a metallized rim along the periphery of the edge.

27. (New) The contact node according to Claim 24, wherein the metallized hole is made in the form of a truncated cone, the lower base of the truncated cones being faced to the contact pad on the surface of the underlying connection layer, and the upper base of the truncated cones being coupled with the conductive paths on the upper surface of the upper-lying connection layer.

28. (New) The contact node according to Claim 27, wherein the upper edge of the metallized hole coupled with the conductive paths on the surface of the connection layer forms a metallized rim long the periphery of the edge.

29. (New) The contact node according to Claim 27, wherein an integrated circuit chip oriented by its metallized contact pads to the corresponding metallized holes in the upper-lying connection layer is used as a connection layer with the metallized contact pads respective to the metallized holes in the upper-lying connection layer.

30. (New) The contact node according to Claim 24, wherein the metallized contact pad is flat.

31. (New) The contact node according to Claim 24, further comprising a protrusion interacting with the respective metallized hole formed in the center of the metallized contact pad respective to the metallized hole.

32. (New) The contact node according to Claim 31, wherein the protrusion is in the form of a cylinder.

33. (New) The contact node according to Claim 31, wherein the protrusion is made in the form of cone.

34. (New) The contact node according to Claim 31, wherein the protrusion is in the form of a sphere.

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35. (New) The contact node according to Claim 31, wherein the protrusion is made of a conductive material.

36. (New) The contact node according to Claim 31, wherein the protrusion is made of a solder.

37. (New) The contact node according to Claim 24, further comprising a contact made in the form of a rod fixed in the underlying connection layer orthogonally to its surface inserted into the metallized hole.

38. (New) The contact node according to Claim 37, wherein the rod has the form of a cylinder.

39. (New) The contact node according to Claim 37, wherein the rod has the form of a polygon.

40. (New) The contact node according to Claim 37, wherein the rod has grooves made along the generatrix thereof.

41. (New) The contact node according to Claim 40, wherein the grooves are interrupted.

42. (New) The contact node according to Claim 37, wherein the rod is made from a conductive material.

43. (New) The contact node according to Claim 37, wherein the rod is made from an electrical insulating material with a conductive coating.

44. (New) The contact node according to Claim 28, wherein the diameter D of the upper base of the truncated cone, the width h of the metallized rim, the diameter d of the lower base of the truncated cone, the thickness t of the dielectric material of the connection layer and the minimal width L of the respective metallized contact pad on the underlying connection layer are coupled with the following relationship:

$$L \geq D + 2h = d + 2t + 2h$$

45. (New) The contact node according to Claim 37, wherein the upper edge of the metallized hole coupled with the conductive paths and a lower edge of the metallized hole form metallized rims on the surfaces of the connection layer along the periphery of the edges.

46. (New) The contact node according to Claim 26, wherein the upper and lower edges of the metallized hole have a facet.

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47. (New) A contact node, comprising:

a first connection layer having a conductive path on a surface thereof;

a second connection layer deposited adjacent to the first connection layer having a conductive path on a surface thereof; and

a metallized hole provided through the first connection layer and having an inner surface thereof connected to the conductive path of the first connection layer; and

a metallized contact pad provided on the surface of the second connection layer and connected with the conductive path of the second connection layer, wherein a conductive binding material is deposited in the metallized hole to be in contact with the inner surface of the metallized hole and the metallized contact pad so as to form connection between the first and second connection layers.

48. (New) The contact node according to Claim 47, wherein the metallized hole is in a form of a cylinder.

49. (New) The contact node according to Claim 48, wherein the metallized contact pad has a mertallized protrusion in a form of a sphere in the conductive binding material.

50. (New) The contact node according to Claim 48, wherein the metallized contact pad has a mertallized protrusion in a form of a cone in the conductive binding material.

51. (New) The contact node according to Claim 48, wherein the metallized contact pad has a mertallized protrusion in a form of a cylinder in the conductive binding material.

52. (New) The contact node according to Claim 48, wherein the metallized contact pad has a mertallized protrusion in a form of a rod in the conductive binding material.

53. (New) The contact node according to Claim 47, wherein the metallized hole is in a form of a truncated cone.

54. (New) The contact node according to Claim 53, wherein the metallized contact pad has a mertallized protrusion in a form of a sphere in the conductive binding material.

55. (New) The contact node according to Claim 53, wherein the metallized contact pad has a mertallized protrusion in a form of a cone in the conductive binding material.

56. (New) The contact node according to Claim 53, wherein the metallized contact pad has a mertallized protrusion in a form of a cylinder in the conductive binding material.

57. (New) The contact node according to Claim 53, wherein the metallized contact pad has a mertallized protrusion in a form of a rod in the conductive binding material.

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REMARKS

The amendments to Claims 24-46 have been made to conform to United States practice. Claims 47-57 have been added. No new matter has been introduced.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 4/27/01

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I hereby certify that the accompanying

Transmittal; International Application as Published; English Translation of the Application; International Search Report; Preliminary Amendment in 5 pages; Declaration and Power of Attorney in 1 pages; Small Entity Statement(s); Check(s) for Filing Fee(s); Return Prepaid Postcard

are being deposited with the United States Postal Service "Express Mail Post Office To Addressee" service under 37 CFR 1.10 on the date indicated above and are addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Carol Macarty

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CONTACT NODE

Field of the invention

The invention relates to the manufacturing of permanent connections in producing the equipment based on microelectronics components and semiconductor devices, and particularly to contact nodes by which the assembling, including the assembling of multilayered connection plates for the multichip modules (MCM) as well as the mounting of LSIC chips in manufacturing the MCM are performed.

Background of the invention

It is known that permanent connections provide a high reproducibility, quality and reliability of an electronic equipment. In the microelectronics equipment designs, most of permanent connections are formed by joining pairs of contact into contact nodes during producing operations (soldering, welding, spraying, galvanic build-up etc.)

At the moment the requirements to provide a speed performance and miniaturization become increasingly crucial in creating and manufacturing the modern electronic equipment.

The promising direction of development is to create the equipment on the base of housing-less components, including LSIC, in the form of multichip modules which are characterized by a high component mounting density, interconnection topology optimization and increase of the speed performance of the MCM equipment.

In that connection, efforts of many microelectronics equipment designers' are directed to develop multilayered connection structures with high interconnection density with a reliable contacting of conductors being in adjacent connection layers as well as methods for joining housing-less components, and first

of all, multi-lead LSIC chips to mounting contacts of multilayered connection structure as a part of the MCM.

One of the almost insurmountable obstacle for obtaining the high interconnection density in the MCM multilayered substrates is in the forming of a great number (several thousands) of reliable contact nodes having identical features and connecting the conductors from different connection layers into single topology of the multilayered structure.

Other, no less hard problem is to joining reliably and reproducibly the contact pads of LSIC chips to respective contact pads of the multilayered MCM structure.

The chips of modern LSICs (for example, Pentium chips) have dimensions exceeding 1 sq. cm, more than 400 contact pads and clock operating frequencies greater than 400 MHz. An assembling of such chips into a single MCM node with chips of Cash memory is a very actual problem. Actuality of this problem would only increase with developing the microelectronics equipment manufacture and LSIC element base.

The contact node as a component of the MCM multilayered connection structure could be a combination of at least two metallized contacts, for example, in the form of coaxially jointed metallized holes made in two adjacent connection layers interconnected electrically and mechanically.

The contact node for mounting a LSIC chip as a component of the MCM also could be represented by a combination of two aligned contacts one of which being on a chip surface and a respective contact being on the MCM mounting layer. The contacts are interconnected by a conductive structure, which could be, depending on forming method, as follows:

– a wire welded to the contacts;

– a jumper formed on the dielectric material film and welded to the contacts;

– a tinned protrusion previously formed on one contact and soldered to another one.

Variety contact node designs for mounting the chips could be divided into following types (Мазур А. и др. Процессы сварки и пайки в производстве полупроводниковых приборов. М.: "Радио и связь", 1991. С. 38-39 – Mazur A. et al. Welding and soldering processes in manufacturing the semiconductor devices. Moscow: "Radio and Sviaz", 1991. Pp. 38-39).

Type 1 is characterized by an arrangement of contacts being connected (one contact on the chip surface, other one on the mounting surface) in different parallel planes. In so doing, the contacts are faced by working surfaces to one side and connected by extended intermediate elements, for example, by wire welded to the contacts.

Type 2 is characterized by an arrangement of contacts in one plane. The contacts are also connected by extended intermediate elements which are beam connectors.

Type 3 is similar to Type 1, the contact pads are also arranged in the parallel planes, but faced to each other with their working surfaces. The intermediate element of extended type is a beam on the polyimide film.

It is necessary to note two main disadvantages of above mentioned types of the contact nodes:

– a utilization of defect-forming producing operations (welding);

– a non-group character of main assembling operations (forming every contact node individually and sequentially, with two weldings for every contact node).

Type 4 is similar to Type 3, but the contacts are mutually aligned, whereby the intermediate element has a minimal extension and is made in the form of protrusion having the bump or ball form previously formed on the chip contact. A connection of the contacts is performed by soldering.

An advantage of the Type 4 contact node is a group character of preliminary and assembling operations (assembling all contact nodes simultaneously).

Main disadvantages are as follows:

– the impossibility to perform direct visual and electrical control of process and results of the contact node assembling due to the fact that the chip turned by its "face" (and all contact pads) to the substrate covers all aligned respective contact pads on the substrate;

– the lack of natural exit for working waste of assembling (for example, the flux) from a very narrow gap between the substrate and chip due to substantial capillary forces in this gap;

– the lack of effective methods for withdrawing the working waste of assembling from the gap between the substrate and chip, which leads to degradation phenomena in the chip during its exploitation and to decreasing in a reliability of the chip operation.

The contact node used in assembling the polyimide connection layers into multilayered operation plate is known, consisting of two contacts in adjacent layers which contacts are made in the form of metallized holes which with form, together with metallized holes of other layers, the matrix of through channels piercing all plate layers throughout. After coaxial alignment and jointing, all pairs of contact through holes are interconnected by the method of vacuum soldering (Панов Е.Н. Особенности сборки специализированных БИС на базовых матричных кристаллах. М.: "Высшая школа", 1990. С. 33-34. - Panov E.N. The peculiarities of assembling the specialized LSIC on basic matrix chips. Moscow: "Vysshaya Shkola", 1990. Pp. 33-34).

However, such construction of the contact node leads to greater expenditure of usable plate area for through channel matrix, which decrease sufficiently the interconnection spreading density, lead to increase number of plate

layers and number of soldered joints, i.e. decrease the manufacture adaptability of the plate and increase its cost while degrading reliability characteristics.

The closest to the present invention by the technical essence and achieved result during its utilization is the contact node including two contacts, one of which contacts is made in the form of metallized tinned protrusion having a bump or ball form on a contact pad of LSIC chip, and the second contact is in the form of metallized contact pad coupled with conductors on a mounting surface of a connection structure. After their aligning, the contacts are interconnected electrically and mechanically by means of a conductive binding structure (Моряков О.С. Технология полупроводниковых приборов и изделий микроэлектроники. М.: "Высшая школа", 1990. С. 38-40 - Moryakov O.S. Technology of semiconductor devices and microelectronics items. Moscow: "Vysshaya Shkola", 1990. Pp. 38-40).

Such contact node design is characterized by:

– great technological difficulties in forming protrusions of complex form and structure and uniform by height on the contact pads of the LSIC chips having a multiplicity of leads (500 contacts and over);

– utilizing the defect-forming producing operations and processes in forming 3D protrusions on the LSIC contact pads;

– the impossibility to perform direct visual and electrical inspection of the process and results in assembling a great number of contact nodes placed in a very narrow gap between the substrate and the chip;

– great difficulties in withdrawing the working waste, being formed during the process of soldering the contact nodes, from the gap between the chip and substrate, which effects negatively on the reliability of connections.

Summary of the invention

The problem to be solved by the present invention consists in creating such universal contact node which utilizing in microelectronics equipment would allow to eliminate the above mentioned disadvantages of contact nodes being existed and utilized in both assembling the multilayered connection structures (MCS) and mounting the chips onto the MCS.

The technical result caused by utilizing the universal contact node of the proposed design in the MCM mass production would allow to provide:

– a high contact spreading density in multilayered structures for the MCM as well as a high density of mounting LSIC chips in the MCM;

– a minimization of parasite impedances in the MCM, improvement of the "signal-noise" ratio in MCM interconnections and substantial increase of operation clock frequencies and speed performance of the MCM equipment;

– a possibility for group manufacturing and preparing the components of the contact nodes for assembling the multilayered connection structures in a single producing cycle;

– a possibility for group assembling all contact nodes in a single operation cycle both in the multilayered connection structures and during the process of mounting chips in MCM devices;

– an exclusion of the defect-forming operations (like welding) during the process of mounting chips in MCM device;

– a separate implementing of the processes of element forming and contact nodes assembling proper, which is particularly important to maintain the reliability resource of LSIC chips sensitive to technological effects;

– an exclusion of the usage of expensive multi-lead housings for LSIC chips in the microelectronics equipment;

– an exclusion of the usage of precious metals and deficit materials;

– a decrease of the cost in producing the microelectronics equipment on a housing-less element base (MCM equipment) to commercially acceptable levels.

The aforementioned technical result is achieved at the cost of fact that the contact node comprising at least two metallized contacts coupled with conductive paths arranged on surfaces of connection layers made on the base of a dielectric material and mutually aligned and interconnected electrically and mechanically by conductive binding material, is a joint between a contact made in the form of metallized contact pad coupled with the conductive paths on the surface of the connection layer, and a respective contact jointed with said pad and made in the form of metallized hole in an upper-lying connection layer, the lower edge of the metallized hole being faced to the metallized contact pad on the surface of the underlying connection layer, and the upper edge of said hole being coupled with the conductive paths on the upper surface of the upper-lying connection layer;

– and also by that the metallized hole is made in the form of cylinder;

– and also by that the metallized hole is made in the form of truncated cone, the lesser base of the truncated cones being faced to the contact pad on the surface of the underlying connection layer, and the greater base of the truncated cones being coupled with the conductive paths on the upper surface of the upper-lying connection layer;

– and also by that an integrated circuit chip oriented by its metallized contact pads to corresponding metallized holes in the upper-lying connection layer is used as a connection layer with metallized contact pads respective to the metallized holes in the upper-lying connection layer;

– and also by that the metallized contact pad is made flat;

– and also by that a protrusion interacting with the respective metallized hole is formed in the center of the metallized contact pad respective to the metallized hole;

– and also by that the protrusion is made from a conductive material in the form of cylinder, cone or sphere;

– and also by that the protrusion is made of solder;

– and also by that a contact respective to the metallized hole is made in the form of a rod fixed in the underlying connection layer orthogonally to its surface and inserted into the metallized hole;

– and also by that the rod is made from a conductive material in the form of cylinder or polygon, and grooves are made along the generatrix of the rod, which grooves could be interrupted;

– and also by that the rod is made from an electrical insulating material with a conductive coating;

– and also by that the upper edge of the metallized hole coupled with the conductive paths and the lower edge of the metallized hole are made with a metallized rim along the periphery of the edge;

– and also by that the upper edge of the metallized hole coupled with the conductive paths on the surface of the connection layer is made with a metallized rim along the periphery of the edge;

– and also by that the diameter D of the greater base of the truncated cone, the width h of the metallized rim, the diameter d of the lesser base of the truncated cone, the thickness t of the dielectric material of the connection layer and the minimal width L of the respective metallized contact pad on the underlying connection layer are coupled with the following relationship:

$$L \geq D + 2h = d + 2t + 2h;$$

– and also by that the upper and lower edges of the metallized hole in the form of cylinder have a facet.

Brief description of the drawings

The invention is illustrated with graphic materials, where Fig. 1, Fig. 2a, b, Fig. 3a, b, Fig. 4a, b, Fig. 5a, b, Fig. 6a, b depict schematically the fragments of proposed contact node.

Fig. 1 schematically depicts the principal view of the contact node.

Fig. 2a depicts the contact node with the metallized hole in the form of cylinder.

Fig. 2b depicts the contact node with the metallized hole in the form of truncated cone.

Fig. 3a depicts the contact node with the metallized hole in the form of cylinder and a protrusion in the form of sphere.

Fig. 3b depicts the contact node with the metallized hole in the form of truncated cone and the protrusion in the form of sphere.

Fig. 4a depicts the contact node with the metallized hole in the form of cylinder and the protrusion in the form of cone.

Fig. 4b depicts the contact node with the metallized hole in the form of truncated cone and the protrusion in the form of cone.

Fig. 5a depicts the contact node with the metallized hole in the form of cylinder and the cylinder protrusion.

Fig. 6a depicts the contact node with the metallized hole in the form of cylinder and a respective contact in the form of rod.

Fig. 6b depicts the contact node with the metallized hole in the form of truncated cone and the contact in the form of rod.

The preferred embodiment of the invention

Referring now to Fig. 1, a contact node comprises a metallized contact pad 1 electrically coupled with conductive path 2 on the surface of an underly-

ing connection layer 3. A respective contact in the form of a metallized hole 4 is made in the upper-lying connection layer 7. The lower edge of metallized hole 4 is jointed with the metallized contact pad 1, and its upper edge is connected via a metallized rim 5 with conductive path 6 on the surface of the upper-lying connection layer 7. A conductive binding material 8 joins electrically and mechanically both contact into a single contact node.

In the case of assembling the contact node by spraying the binding material 8, the metallized hole 4 is aligned with the respective metallized contact pad 1, a protective mask (not shown in Fig. 1) is superimposed, aligned and fixed, after which the assembled technological stack is placed into the spraying plant, where a successive layer-by-layer spraying of the conductive materials forming a conductive binding structure with necessary features is performed.

In that a way is performed a group assembling of the great number of the contact nodes coupling the conductors in adjacent connection layers of the multilayered connection structure or the contact pads of the chips with respective contacts of the mounting layer of the multilayered connection structure in the MCM.

After connecting the layers in the spraying plant, if necessary, a step of visual and electrical inspecting of the formed contact node quality is performed.

When assembling the contact nodes by soldering, all metallized contact pads previously tinned are aligned with the respective metallized holes being also tinned, the surfaces with the contacts are fixed relatively to each other, for example, by glue composition, after which the stack is placed into the vacuum soldering plant. In conditions of partial vacuum and common heating up to the temperature of solder melting, a joint soldering in every contact node is occurred simultaneously under effect of capillary forces.

Fig. 2a, Fig. 2b depicts the contact nodes with the flat metallized contact pad 1, in one case the respective metallized hole being made in the form of cylinder 4, and in other in the form of the truncated cone 4.

Fig. 3a, Fig. 3b depicts the contact nodes with the metallized holes in the form of cylinder 4 and truncated cone 4 accordingly, and the respective metallized contact pads 1 have the metallized protrusion in the form of a sphere 9 in the central part.

Fig. 4a, Fig. 4b depicts the contact nodes with the metallized holes in the form of cylinder 4 and truncated cone 4 accordingly, and the respective metallized contact pads 1 have the metallized protrusion in the form of a cone 9 in the central part.

Fig. 5a, Fig. 5b depicts the contact nodes with the metallized holes in the form of cylinder 4 and truncated cone 4 accordingly, and the respective metallized contact pads 1 have the metallized protrusion in the form of a cylinder 9 in the central part.

Such contact nodes are suitable both for assembling by spraying and for assembling by soldering.

The presence of the protrusion in the central part of the metallized contact pad inserted into the metallized hole allows to ensure the reliable alignment of the elements simultaneously for a great number of the contact nodes without utilizing the precision systems of aligning, thereby substantially reducing the labor input and duration of the operations of aligning and mutual positioning the connection layers, and also of operations of oriented placing the multi-lead LSIC chips on the mounting connection structure when forming the corresponding protrusions on the metallized contact pads of LSICs.

Moreover, the metallized protrusion increases the overall area of electrical contacting of the elements of the contact node and also its mechanical strength.

Fig. 6a, Fig. 6b depicts the contact nodes with the metallized holes in the form of cylinder 4 and truncated cone 4 accordingly, and the respective metallized contacts are made in the form of rods 9 inserted into the metallized holes 4.

Such design of the contact node allows a simple and reliable joining of several connection layers with the chips mounted on them into a single multichip module of a high degree of integration, and also to provide the forming of joint connectors with pin contacts as a part of the multilayered connection structures.

An interaction of the contact node elements during their functioning occurs as follows (by the example of Fig. 1 fragment).

A signal from the conductive path 6 of the connection layer 7 passes through the metallized hole 4 in the connection layer 7, the conductive binding material 8 and the metallized contact pad 1 on the surface of the connection layer 3 to the conductive path 2. Thereby the electrical connection of the conductive path 6 on the upper-lying connection layer 7 with the conductive path 2 in the underlying connection layer 3 takes place.

Industrial applicability

An implementation of the contact node in accordance with the present invention allows to provide:

– a group character of the process for forming the contact nodes both in assembling the multilayered connection plates and structures and in mounting the housing-less LSIC chips in one-chip and multichip modules, thereby providing a high productivity of electronic equipment assembling;

– an exclusion from the route of assembling the defect-forming welding processes, thereby providing a high percentage of valid item production in their manufacturing and a high reliability of the equipment in the exploitation;

– a high specific density of the connection elements of multilayered connection plates and structures while minimizing the number of connection layers;

– a high density of mounting of the housing-less LSIC chips and other components with planar arrangement of the metallized contact pads consisting in the multichip modules, thereby substantially increasing the specific functional characteristics of such electronic equipment;

– a utilization of LSIC chips with matrix arrangement of the metallized contact pads on the surface of the chips in the coordinate grid having a predefined step;

– finally, aforementioned main advantages of the proposed contact node allow a substantial reduce of the assembling and equipment cost while increasing the equipment quality and reliability.

Claims

1. A contact node comprising at least two metallized contacts coupled with conductive paths arranged on surfaces of connection layers made on the base of a dielectric material and mutually aligned and interconnected electrically and mechanically by conductive binding material, *characterized* in that it is made in the form of joint between a contact made in the form of metallized contact pad coupled with the conductive paths on the surface of the connection layer, and a respective contact jointed with said pad and made in the form of metallized hole in an upper-lying connection layer, the lower edge of the metallized hole being faced to the metallized contact pad on the surface of the underlying connection layer, and the upper edge of said hole being coupled with the conductive paths on the upper surface of the upper-lying connection layer.

2. The contact node according to claim 1, *characterized* in that the metallized hole is made in the form of cylinder.

3. The contact node according to claim 2, *characterized* in that the upper edge of the metallized hole coupled with the conductive paths on the surface of the connection layer is made with a metallized rim along the periphery of the edge.

4. The contact node according to claim 1, *characterized* in that the metallized hole is made in the form of truncated cone, the lesser base of the truncated cones being faced to the contact pad on the surface of the underlying connection layer, and the greater base of the truncated cones being coupled with the conductive paths on the upper surface of the upper-lying connection layer.

5. The contact node according to claim 4, *characterized* in that the upper edge of the metallized hole coupled with the conductive paths on the surface of the connection layer is made with a metallized rim along the periphery of the edge.

6. The contact node according to claim 4, *characterized* in that an integrated circuit chip oriented by its metallized contact pads to corresponding metallized holes in the upper-lying connection layer is used as a connection layer with metallized contact pads respective to the metallized holes in the upper-lying connection layer.

7. The contact node according to claim 1, *characterized* in that the metallized contact pad is made flat.

8. The contact node according to claim 1 or 6, *characterized* in that a protrusion interacting with the respective metallized hole is formed in the center of the metallized contact pad respective to the metallized hole.

9. The contact node according to claim 8, *characterized* in that the protrusion is made in the form of cylinder.

10. The contact node according to claim 8, *characterized* in that the protrusion is made in the form of cone.

11. The contact node according to claim 8, *characterized* in that the protrusion is made in the form of sphere.

12. The contact node according to claim 8, *characterized* in that the protrusion is made of a conductive material.

13. The contact node according to claim 8, *characterized* in that the protrusion is made of solder.

14. The contact node according to claim 1, *characterized* in that a contact made in the form of a rod fixed in the underlying connection layer orthogonally to its surface is inserted into the metallized hole.

15. The contact node according to claim 14, *characterized* in that the rod has the form of cylinder.

16. The contact node according to claim 14, *characterized* in that the rod has the form of polygon.

17. The contact node according to claim 14, *characterized* in that grooves are made along the generatrix of the rod.

18. The contact node according to claim 17, *characterized* in that the grooves are made interrupted.

19. The contact node according to claim 14, *characterized* in that the rod is made from a conductive material.

20. The contact node according to claim 14, *characterized* in that the rod is made from an electrical insulating material with a conductive coating.

21. The contact node according to claim 5, *characterized* in that the diameter D of the greater base of the truncated cone, the width h of the metallized rim, the diameter d of the lesser base of the truncated cone, the thickness t of the dielectric material of the connection layer and the minimal width L of the respective metallized contact pad on the underlying connection layer are coupled with the following relationship:

$$L \geq D + 2h = d + 2t + 2h$$

22. The contact node according to claim 14, *characterized* in that the upper edge of the metallized hole coupled with the conductive paths and a lower edge of the metallized hole are made with metallized rims on the surfaces of the connection layer along the periphery of the edges.

23. The contact node according to claim 3, *characterized* in that the upper and lower edges of the metallized hole have a facet.

Abstract

The invention relates to the manufacturing of permanent connections in producing the equipment based on microelectronics components and semiconductor devices, and particularly to contact nodes by which the assembling, including the assembling of multilayered connection plates for the multichip modules (MCM) as well as the mounting of LSIC chips in manufacturing the MCM are performed. The contact node comprises at least two metallized contacts coupled with conductive paths (2, 6) arranged on surfaces of connection layers (3, 7) made on the base of a dielectric material and mutually aligned and interconnected electrically and mechanically by conductive binding material (8). The contact node is a joint between a contact made in the form of a metallized pad (1) coupled with a the conductive paths (2) on the surface of the underlying connection layer (3) and a respective contact made in the form of a metallized hole (4) in a dielectric material layer.

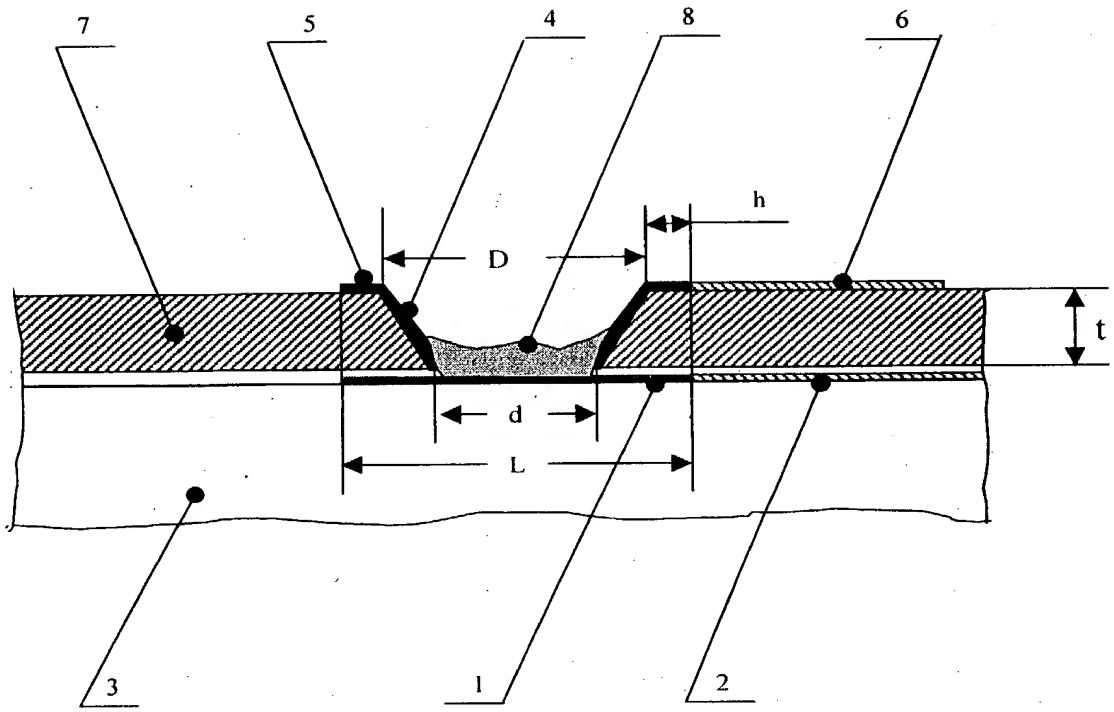

Fig. 1

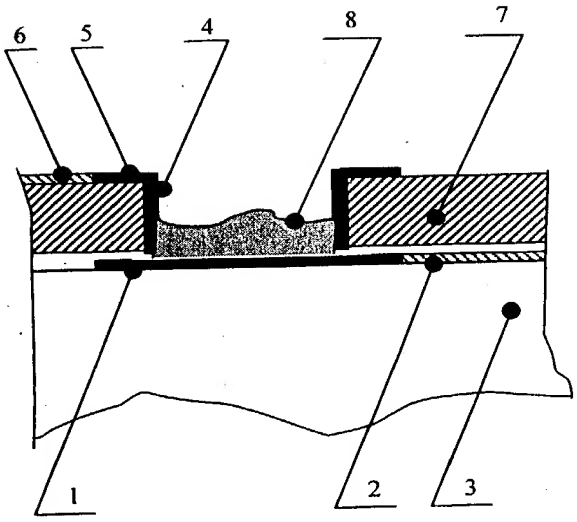

Fig..2a

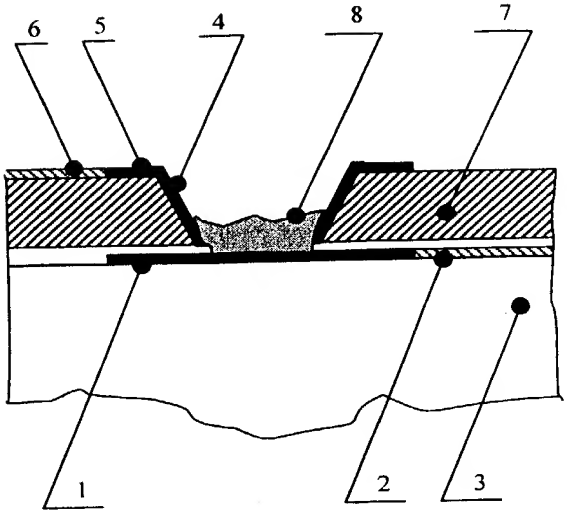

Fig..2b

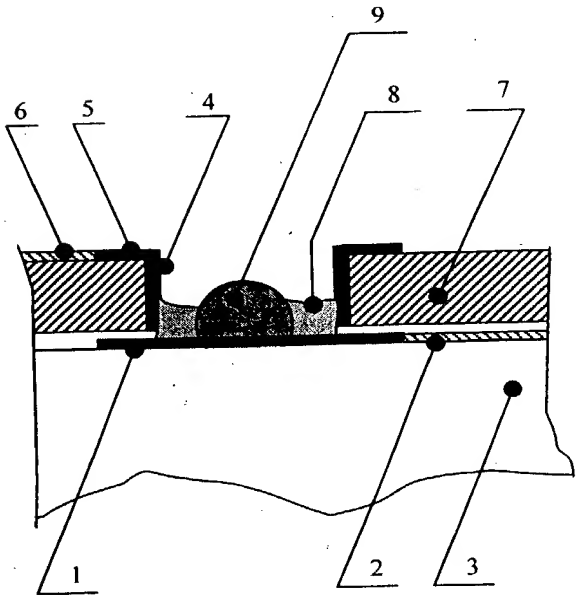

Fig .3a

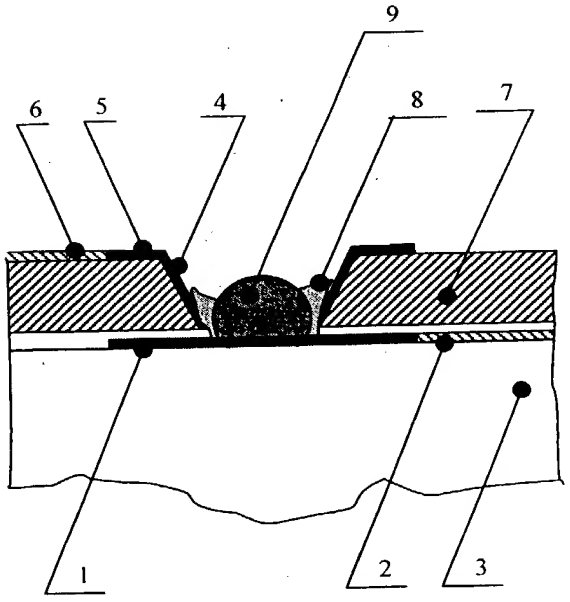

Fig.3b

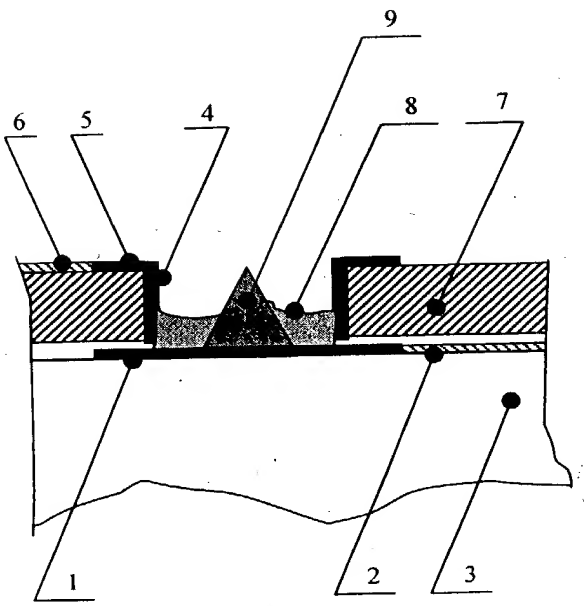

Fig .4a

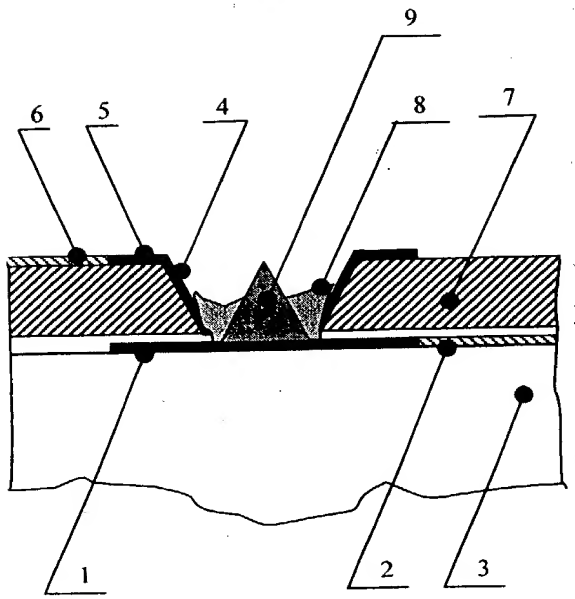

Fig .4b

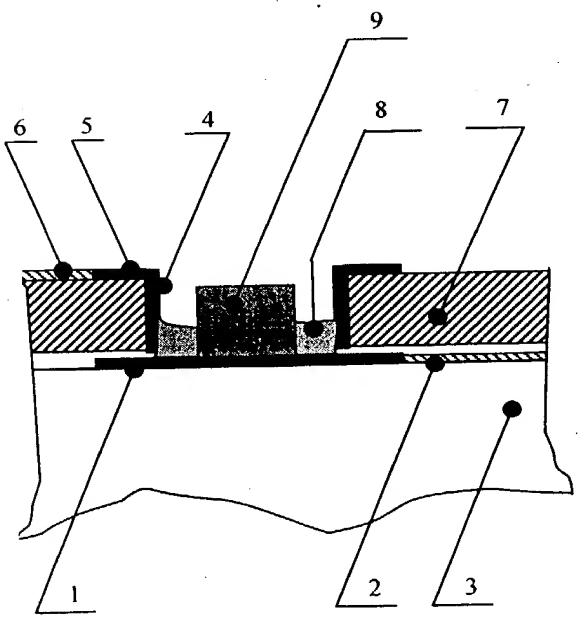

Fig .5a

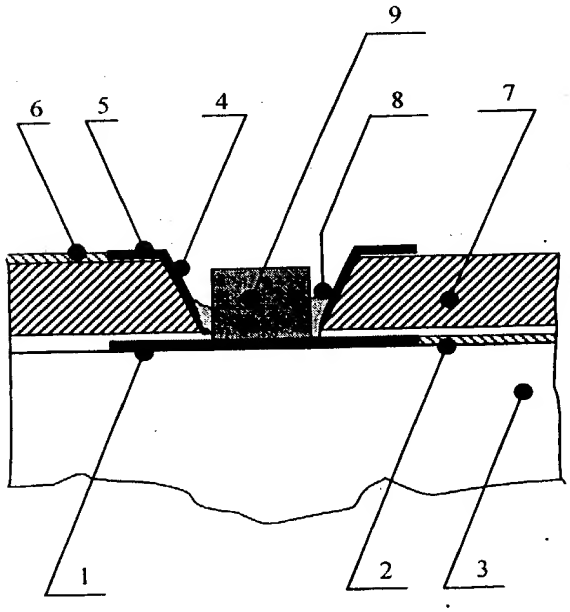

Fig .5b

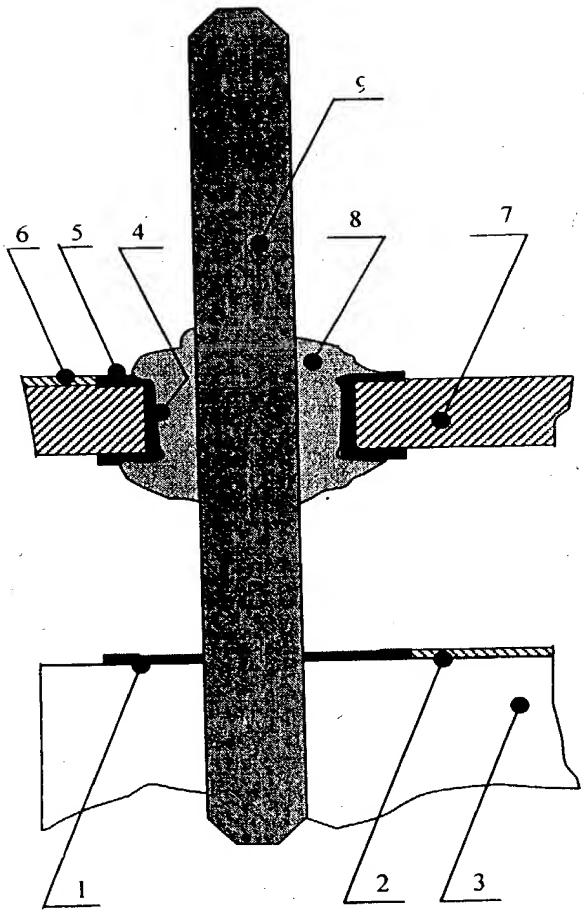

Fig. 6a

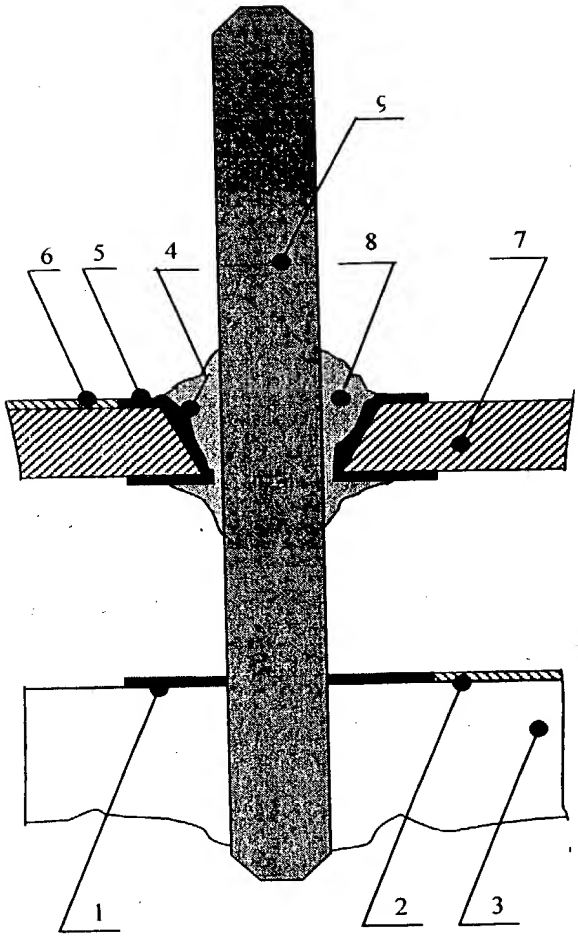

Fig. 6b

Combined Declaration For Patent Application and Power of Attorney (Continued)
(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER: VALER11.001APC

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowlege the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)		

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(List name and registration number)*

Send Correspondence to:	Direct Telephone Calls to: (name and telephone number)

201	FULL NAME OF INVENTOR	FAMILY NAME: TARAN	FIRST GIVEN NAME: Alexandr	SECOND GIVEN NAME: Ivanovich
	RESIDENCE & CITIZENSHIP	CITY: Moscow RUX	STATE OR FOREIGN COUNTRY: Russian Federation	COUNTRY OF CITIZENSHIP: Russian Federation
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: 103575, Zelenograd, korp. 1001, kv8	CITY: Moscow	STATE & ZIP CODE/COUNTRY: Russian Federation
202	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
203	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

100

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE: 01.02.2001.	DATE	DATE

09830635 . 080201

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	ATTORNEY'S DOCKET NUMBER VALERT1.001APC

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: CONTACT NODE

the specification of which (check only one item below):

☐ is attached hereto.

☒ was filed as United States application

Serial No. 09/830,635

on April 27, 2001

and was amended

on _____ (if applicable).

☒ was filed as PCT international application

Number PCT/RU 99/00062

on 04 March 1999

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowlege the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (Day, Month, Year)	PRIORITY CLAIMED UNDER 35 USC 119
RU	98121773/09	08 December 1998	☒ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

Applicant or Patentee: Alexander I. Taran Attorney's
Serial or Patent No.: _____ Docket No.: _____
Filed or Issued: _____
For: Contact node

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9 (f) and 1.27 (b)) — INDEPENDENT INVENTOR

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9 (c) for purposes of paying reduced fees under section 41 (a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled Contact node described in

[X] the specification filed herewith
[ ] application serial no. _____, filed _____.
[ ] patent no. _____, issued _____.

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9 (c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9 (d) or a nonprofit organization under 37 CFR 1.9 (e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

[ ] no such person, concern, or organization
[X] persons, concerns or organizations listed below*

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

FULL NAME TARAN ALEXANDER IVANOVICH
ADDRESS Zelenograd, korp.1001, kv.8, Moscow, RU
[X] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

FULL NAME _____
ADDRESS _____
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

FULL NAME _____
ADDRESS _____
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

TARAN, Alexander I.

NAME OF INVENTOR	NAME OF INVENTOR	NAME OF INVENTOR
Signature of Inventor	Signature of Inventor	Signature of Inventor
Date 01.02.2001.	Date	Date